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STANDARD WEIGHTS AND MEASURES.

LETTER

OF

THE SECRETARY OF THE TREASURY,

COMMUNICATING

A report of the Superintendent of the construction of standard weights, measures, and balances.

AUGUST 8, 1846.

Read, and laid upon the table.

TREASURY DEPARTMENT, *August* 7, 1846.

SIR: I have the honor to transmit, herewith, a report of the progress made in the construction of standard weights, measures, and balances, during the year 1845, under the superintendence of Professor Alexander D. Bache.

All which is respectfully submitted.

R. J. WALKER,
Secretary of the Treasury.

Hon. JOHN W. DAVIS,
Speaker of the House of Representatives.

Report to the Treasury Department, by Professor Alexander D. Bache, on the progress of the work of constructing standards of weights and measures, and balances, in the year 1845.

OFFICE OF WEIGHTS AND MEASURES,
Washington, April 25, 1846.

SIR: I have the honor to submit to you a report on the progress of the work of making standards of weights and measures, and balances, for the past year.

This work has been under my direction for the last two years, during nearly the whole of which I have had the very able assistance of Joseph Saxton, esq., formerly balance maker to the United States mint. The same number of mechanicians and laborers have been employed as in past years.

In my report of last year I gave a brief sketch of the work, from its be-

ginning, by Mr. Hassler, and a special account of the progress during the year 1844. I propose now to give a similar account of the work done in 1845.

At the close of 1844 the making and distributing of standard weights for the custom-houses and States had been completed, and the smaller capacity measures, up to the gallon, inclusive, had been made and adjusted before the close of February, 1845. Thirteen days in March and April, 1844, were occupied in the adjustment of the half-bushel measures, which was continued in January, February, and March, 1845, and completed in January of this year, except the verifications and certain experiments, which will be detailed, which were made in February and March. One hundred and twenty-one (121) half-bushel measures have been finished, adjusted, and packed, ready for delivery. Of these, two have been weighed, after their final adjustment, seven times; one, six times; two, five times; seven, four times; seventeen, three times; ninety-one, twice; and one, once.

The comparison and adjustment of a new apparatus for the measuring of bases in the survey of the coast was made in the autumn of 1845.

A new apparatus has been constructed upon the principle of Mr. Saxton's reflecting pyrometer for comparing the standard measures of length. The great simplicity and accuracy of this apparatus will, I am sure, warrant the change from any of the ordinary forms to this. It will be described with the verification and comparison of the length measures. The trials heretofore made with it are only preliminary to its use.

The work on the balances has occupied twelve mechanics and laborers during the year, and the progress up to January, 1846, will be stated in detail. On the first of January, 1846, there were 28 balances ready for delivery.

The work in relation to a standard hydrometer was, as stated in my last report, committed by the Treasury Department, under my direction, to Professor R. S. McCulloch, in connexion with researches in regard to sugars and sirups called for by the act of Congress of July 21, 1842. A preliminary report of his investigations was laid before Congress at the last session, and a final report may be expected within the present year.

I proceed to give the necessary particulars in regard to the adjustment of the standard half-bushels, and to the construction of the balances; after which, the progress of the work just stated, in general terms, will be shown in numbers.

ADJUSTMENT OF THE HALF-BUSHEL STANDARD MEASURES.

These measures are cylinders, of which the height is about one and three-quarters of the diameter. They are cast in one piece. The general thickness of the metal is about three-sixteenths of an inch, except at the upper and lower base, and about two inches from the upper base, where there are projecting rims, the one below the upper base serving to handle the measure. Every half-bushel is provided with a glass cover, to *strike* it. Before attempting the adjustment, the measure is finished, except the final polishing necessary after the handling in the adjustments.

The process for bringing the measures to the capacity required for standards was essentially the same with that described in the report of the last year in reference to the gallon measures. The conditions in regard

to temperature were of course the same, as the capacity of these measures also is regulated by the weight of distilled water which they contain at the maximum density of water, and in an atmosphere of the density corresponding to the pressure of thirty inches of mercury. At this temperature and pressure the half-bushel should contain, according to Mr. Hassler, 271,695.9 grains (of the standard Troy pound, or 38.8137 pounds avoirdupois) of water.

The balance described by Mr. Hassler, in his report for 1842, was used in the adjustments and comparisons. For the mode of indicating the horizontality of the beam there described was substituted an index-rod, passing vertically downwards from the middle of the beam, the end of which played in front of a graduated arc. The balance was enclosed in a case, to avoid, as far as practicable, the effect of currents of air. The front of the case was formed by glass doors, sliding in vertical grooves, and counterpoised.

When loaded with one hundred pounds in each scale, this balance shows with certainty two-tenths of a grain, and frequently, when in the last condition, one-tenth. The former corresponds to $\frac{1}{2\,8\,8\,0\,0\,0}$ part of the weight. The certainty of the adjustment of the half-bushel measures is, however, considerably less than this.

The experiments upon which the statement of the sensibility of the balance rests are recorded in the following table: When one-tenth of a grain was placed in the right hand scale, the oscillations of the index were observed as stated in the first and second columns. The mean shows a change of position of one-tenth of one of the divisions upon the graduated arc. When two-tenths of a grain were similarly placed, the change of position of the index was as shown in the table, nearly two-tenths of a division; and when one grain was so placed, nearly one division.

TABLE No. 1.

Showing the sensibility of the balance used in adjusting the half-bushel measures, when loaded with one hundred pounds avoirdupois in each scale.

1 grain in right hand scale.					2 grains in right hand scale.					1 grain in right hand scale.				
Left hand.	Right hand.	Means.		Difference.	Left hand.	Right hand.	Means.		Difference.	Left hand.	Right hand.	Means.		Difference.
		Left.	Right.				Left.	Right.				Left.	Right.	
	1.8					1.60					2.20			
1.7	–	1.7	1.75	0.05	1.4	–	1.4	1.57	0.17	1.20	–	1.20	2.15	0.95
	1.7	1.6	1.70	0.10		1.55	1.4	1.55	0.15		2.10	1.17	2.10	0.93
1.5	–	1.5	1.65	0.15	1.4	–	1.4	1.57	0.17	1.15	–	1.15	2.12	0.97
	1.6					1.60	1.4	1.60	0.20		2.15			
		1.5	1.60	0.10	1.4	–	1.4	1.60	0.20					
1.5	–	1.5	1.60	0.10		1.60	1.4	1.60	0.20					
	1.6	1.5	1.60	0.10	1.4									
1.5														
			Mean	0.10				Mean	0.18				Mean	0.95

The arrangements for adjusting the half-bushel measures were as follows:

The measures to be adjusted, with their glass covers, were placed, on the afternoon of the day before that on which they were to be tried, in the adjusting room, side by side, and near them the water to be used in determining their capacity, the water being in a glass vessel with a paper cover. It was freshly distilled every day for the operations of the next day. If the temperature of the room and water was not the same nearly, or if, being the same, the temperature was near that part of the scale where the density of water changes rapidly, the adjustment was not attempted. All circumstances being favorable, the first step was—

1. To ascertain roughly the temperature of the measure, which was, of course, nearly that of the room.

2. The half-bushel measure of which the capacity was to be determined was placed upon one of the scales of the balance, and inside of it a brass weight equivalent to the weight of water which the half-bushel should contain at the standard temperature. The glass cover was made to slide upon the rim of the measure so as to cover it, the rough or ground side of the glass being below or towards the water. The barometer was noted, its height entered in the third column of the table, (the number of the measure and the date of observation being entered in columns one and two—see table No. 3,) and the correction found necessary to reduce it to thirty inches was applied by a small weight in one of the scales. The equilibrium was made perfect, and tried by at least three oscillations, the glass case about the balance being closed.

3. The scale on which the measure stood was now clamped by the pincers below it. The cover was removed; the weight taken from the interior. Distilled water was introduced by a syphon passing through the back of the case. The syphon is of sheet tin, and has a very small exhausting tube in front. Bubbles of air which might adhere to the sides of the measure were removed with a feather. When the measure was nearly full the syphon was drawn up, and the glass cover was pushed slowly over the rim or lip of the measure, and water poured in front to supply any deficiency. The glass cover belonging to the measure was used in the operation, being marked with the same number as the measure itself. If too much water was introduced, the excess was drawn out with a syringe. Air bubbles were carefully removed as the cover passed over. Every endeavor was, however, made to avoid the necessity for these manipulations. When the glass cover was nearly in place, the rim of the measure was carefully wiped before moving the cover to its place. A film of water was drawn into the capillary space between the cover and rim, extending nearly round. It has not been noticed that the changes in this film, in different weighings, affect the results so as to enable the operator to judge of the changes beforehand. It is possible, therefore, that other causes of inaccuracy mask the effect of this. This source of error enters, however, with others, into the estimate of probable errors, which will hereafter be made.

The pincers were then opened so as to set the balance free, and the equilibrium was made by placing small weights in either scale.

The time of vibration of the balance thus loaded is about 39 seconds.

The weight necessary to produce equipoise was entered in the fifth column of the table. The temperature of the water was next ascertained

and recorded in the fourth column, and the water drawn off with a syphon, to be returned to the glass vessel containing the water used for adjustment.

5. The temperature of the measure was next ascertained approximately by placing a thermometer in the interior, which finished the experiment. The object of this last measurement is merely to ascertain that the temperature has not changed too much during the weighing.

During all these operations the measure was handled with buckskin gloves.

6. By applying the correction for temperature from the sixth column to the difference at the temperature of observation, as contained in the fifth column, the number of grains was found by which the measure was too large or too small.

The weighings were all made with care; but those of preliminary adjustment less carefully, of course, than the final comparisons.

The adjustment of the half-bushels was made by the same workman heretofore employed in this work, who has acquired a very considerable dexterity in their manipulation, requiring to be witnessed to be fully appreciated. The mode of verifying will be referred to hereafter.

The steps of the adjustment, by which the measures were brought sufficiently near adjustment to be used as standards, resembled those described in reference to the adjustment of the gallons in my report of last year. They are illustrated by examples in the following table, where the results of the successive trials of twenty measures are set down, until the measure is brought within the limit of accuracy required for a standard. The sign + in this table signifies that the measure is too small, and — that it is too large. The numbers denote the grains and decimals of a grain of distilled water, corresponding to the bulk, by which the measure falls short or exceeds the standard capacity.

The trials are arranged according to their dates.

TABLE No. 2.

Illustrating the steps towards the final adjustment of the half bushel measures.

No. of measure.	1844.												
	March.										April.		
	16	18	19	20	21	22	23	25	26	27	2	3	4
32	—4.07	—2.99	+0.72	Final.									
33	+9.63	+11.17	—23.99	—4.30	—3.32	0.00	Final.						
34	—99.45	—55.15	—32.20	—28.10	+0.18	Final.							
38	+1.18	+0.84	Final.										
41	-	-	-	—28.94	—12.78	+0.16	Final.						
46	-	-	-	-	-	-	—69.00	-	—37.15	—17.52	—15.00	—5.98	—3.11
48	-	-	-	-	-	-	—90.00	-	—45.60	—17.52	—17.50	—5.00	—2.82
51	-	-	-	-	-	-	—59.41	—28.01	—12.10	—4.92	-	+0.06	Final.
52	-	-	-	-	-	-	-	-	-	-	-	—75.01	
54	-	-	-	-	-	-	-	-	-	-	-	-	—50.11

TABLE No. 2—Continued.

No. of measure.	1845.																	
	January.										March.							
	15	16	17	18	20	21	22	23	24	25	20	21	22	24	25	26	27	28
46	+1.62	Final.																
48	—0.11	Final.																
52	—77.51	–	—33.20	–	—5.40	—0.20	Final.											
54	—49.01	+1.07	—34.20	–	—0.22	Final.												
60	–	—76.60	—49.60	–	–	—10.30	—5.80	—5.09	—3.70	+0.55	Final.							
63	–	–	—84.10	—39.10	–	–	—14.80	—10.20	—6.50	+0.10	Final.							
134	–	–	–	–	–	–	–	–	–	–	—46.10	—7.40	+5.50	+2.10	—0.61			
137	–	–	–	–	–	–	–	–	–	–	–	–	–	—92.20	—35.60	—7.94	—8.41	—3.40
144	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	—124.70

TABLE No. 2—Continued.

No. of measure.	January, 1846.															
	7	8	9	10	12	13	14	15	16	17	19	20	21	22	23	
134	+2.80	+1.66	Final.													
137	+7.40	−17.58	+1.44	Final.												
144	–	–	−35.80	−10.30	−9.07	−4.46	+0.03	Final.								
150	–	–	–	–	−49.14	−10.81	−4.44	−2.55	−5.19	−0.41	Final.					
155	–	–	–	–	–	–	–	−39.85	−29.62	−21.42	+5.07	−0.23	Final.			
159	–	–	–	–	–	–	–	+5.38	–	–	–	–	+1.43	Final.		
160	–	–	–	–	–	–	–	–	–	–	−40.32	−12.79	+5.57	+3.17	+0.08	Final.
161	–	–	–	–	–	–	–	–	–	–	–	+3.04	−8.03	+1.50	Final.	

It appears from this table, that, of the twenty half-bushel measures referred to in it, one required eight weighings before it was brought to the condition of final adjustment; four required seven weighings; four, six weighings; six, five weighings; three, three; and two, two weighings. Between each two weighings the measure was enlarged by grinding the interior, or diminished by grinding off the lip, according to the result of the previous weighing.

The following table (No. 3) contains the result of the weighings for the comparison of the standard half bushels, after they were brought to the condition of final adjustment. The first column contains the number of the measure; the next, the date of the experiment; the third, the height of the barometer at the time of weighing; the fourth, the temperature of the distilled water used in adjusting; the fifth, the excess (marked —) or the defect (marked +) of capacity, as compared with the standard at the temperature of observation, expressed in grains of distilled water; the sixth, the correction to reduce the observed weight of water to the weight at the maximum of density; the seventh, the resulting excess or deficiency of the measure at the standard temperature; the eighth, the mean of several trials.

No. 44 requires further trial.

TABLE No. 3.

Showing the final adjustment of the half-bushel measures.

No. of standard.	Date.	Barometer.	Temperature of water.	Difference of weight from standard.	Correction for temperature.	Result. — Too large. + Too small.		
						Single.	Mean.	Corrected mean.
		Inches.	*Fahrenheit.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*
31	Mar. 19, 1844	30.24	50.2	−16.5	−16.06	−0.44		
	April 1, 1844	30.60	48.0	−23.3	−23.90	+0.60	+0.08	+0.56
32	Mar. 19, 1844	30.24	50.1	−16.3	−16.54	+0.24		
	April 1, 1844	30.60	50.6	−14.2	−13.98	−0.22	+0.01	+0.49
33	Mar. 22, 1844	29.80	47.8	−24.8	−24.32	−0.48		
	April 1, 1844	30.65	50.3	−13.8	−15.58	+1.78	+0.65	+1.13
34	Mar. 21, 1844	29.90	50.9	−12.6	−12.26	−0.34		
	Mar. 22, 1844	29.80	50.5	−17.2	−14.54	−2.66		
	April 1, 1844	30.65	49.9	−17.2	−17.42	+0.22	−0.93	−0.45
36	Mar. 20, 1844	29.82	49.7	−18.4	−18.20	−0.20		
	April 1, 1844	30.65	49.7	−19.3	−18.20	−1.10	−0.65	−0.17
37	Mar. 21, 1844	29.90	50.4	−15.8	−15.10	−0.70		
	Mar. 22, 1844	29.80	50.4	−14.3	−15.10	+0.80		
	April 1, 1844	30.60	49.4	−18.6	−19.38	+0.78	+0.29	+0.77
38	Mar. 18, 1844	29.55	50.2	−15.7	−16.06	+0.36		
	April 1, 1844	30.65	49.2	−21.5	−20.22	−1.28	−0.46	+0.02
39	Mar. 20, 1844	29.80	49.4	−19.1	−19.38	+0.28		
	April 1, 1844	30.63	49.0	−21.4	−21.06	−0.34	−0.03	+0.45
40	Mar. 21, 1844	29.90	50.3	−15.3	−15.58	+0.28		
	Mar. 22, 1844	29.80	50.2	−16.4	−16.06	−0.34		
	April 1, 1844	30.63	48.9	−21.9	−21.38	−0.52	−0.19	+0.29
41	Mar. 22, 1844	29.80	50.6	−14.3	−13.98	−0.32		
	April 2, 1844	30.72	49.6	−18.9	−18.60	−0.30	−0.31	+0.17
43	Mar. 25, 1844	30.11	49.2	−19.8	−20.22	+0.42		
	April 2, 1844	30.72	49.5	−19.0	−18.99	−0.01	+0.20	+0.68
44	April 2, 1844	30.72	49.4	−20.2	−19.38	−0.82	−0.82	−0.34
45	April 4, 1844	30.15	53.4	+ 4.7	+ 5.11	−0.41		
	Jan. 15, 1845	30.26	49.0	−18.5	−21.06	+2.56		
	Feb. 10, 1845	30.17	48.6	−20.8	−22.37	+1.57		
	Mar. 1, 1845	29.92	49.8	−19.1	−17.81	−1.29		
	Jan. 5, 1846	30.23	49.3	−17.2	−19.81	+2.61	+1.00	+1.48
46	Jan. 15, 1845	30.26	48.7	−20.9	−22.04	+1.14		
	Mar. 1, 1845	29.92	50.0	−18.4	−17.02	−1.38	−0.12	+0.36
47	April 4, 1844	30.15	53.4	+ 5.7	+ 5.11	+0.59		
	Jan. 15, 1845	30.26	48.4	−23.8	−22.93	−0.87		
	Mar. 5, 1845	29.50	50.4	−16.1	−15.10	−1.00	−0.43	+0.05
48	Jan. 15, 1845	30.26	48.3	−23.8	−23.21	−0.59		
	Mar. 5, 1845	29.50	50.3	−17.6	−15.58	−2.02		
	Mar. 6, 1845	30.30	51.5	−10.5	− 8.73	−1.77	−1.46	−0.98
49	Mar. 27, 1844	30.05	55.3	+22.4	+22.53	−0.13		
	April 2, 1844	30.72	49.4	−18.6	−19.38	+0.78	+0.32	+0.80
50	April 4, 1844	30.15	53.3	+ 5.2	+ 4.42	+0.78		
	Jan. 15, 1845	30.26	48.2	−24.7	−23.49	−1.21		
	Mar. 5, 1845	29.50	50.3	−16.6	−15.58	−1.02	−0.48	0.00
51	April 3, 1844	30.45	49.4	−19.8	−19.38	−0.42		
	April 4, 1844	30.15	53.2	+ 6.0	+ 3.75	+2.25	+0.91	+1.39
52	Jan. 21, 1845	29.89	49.9	−18.1	−17.42	−0.68		
	Mar. 5, 1845	29.50	50.3	−18.2	−15.58	−2.62	−1.65	−1.17
53	Jan. 21, 1845	29.89	49.8	−17.1	−17.81	+0.71		
	Mar. 6, 1845	30.27	51.9	− 8.1	− 6 32	−1.78	−0.53	−0.05
54	Jan. 20, 1845	30.20	49.6	−19.3	−18.60	−0.70		
	Feb. 4, 1845	29.33	49.0	−19.7	−21.06	+1.36		
	Mar. 6, 1845	30.27	51.8	− 7.5	− 6.99	−0.51	+0.05	+0.53
55	Jan. 21, 1845	29.90	49.7	−18.9	−18.20	−0.70		

TABLE No. 3—Continued.

No. of standard.	Date.	Barometer.	Temperature of water.	Difference of weight from standard.	Correction for temperature.	Result. — Too large. + Too small.		
						Single.	Mean.	Corrected mean.
		Inches.	*Fahrenheit.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*
55	Mar. 6, 1845	30.27	51.7	— 8.0	— 7.57	—0.43	—0.56	—0.6
56	Jan. 22, 1845	30.24	50.0	—16.8	—17.02	+0.22		
	Feb. 4, 1845	29.37	48.7	—21.3	—22.04	+0.74		
	Mar. 6, 1845	30.27	51.6	—10.0	— 8.15	—1.85	—0.30	+0.1
57	Jan. 21, 1845	29.90	49.4	—20.0	—19.38	—0.62		
	Mar. 6, 1845	30.30	51.5	—10.3	— 8.73	—1.57	—1.09	—0.6
58	Jan. 22, 1845	30.24	49.9	—16.6	—17.42	+0.82		
	Mar. 7, 1845	30.22	54.0	+ 9.0	+ 9.95	—0.95	—0.06	+0.4
59	Jan. 21, 1845	29.90	49.3	—20.1	—19.81	—0.29		
	Mar. 7, 1845	30.22	53.7	+ 7.5	+ 7.37	+0.13	—0.08	+0.4
60	Jan. 25, 1845	29.47	52.6	— 1.4	— 1.47	+0.07		
	Mar. 7, 1845	30.22	53.7	+ 5.1	+ 7.37	—2.27	—1.10	—0.6
61	Jan. 23, 1845	30.50	50.5	—14.6	—14.54	—0.06		
	Mar. 7, 1845	30.22	53.5	+ 7.0	+ 5.79	+1.21	+0.57	+1.0
62	Jan. 25, 1845	29.47	52.3	— 4.1	— 3.60	—0.50		
	Mar. 7, 1845	30.22	53.5	+ 6.5	+ 5.79	+0.71	+0.10	+0.3
63	Jan. 25, 1845	29.47	52.2	— 4.7	— 4.32	—0.38		
	Mar. 7, 1845	30.22	53.4	+ 4.2	+ 5.11	—0.91	—0.64	—0.1
64	Jan. 25, 1845	29.50	51.9	— 6.8	— 6.32	—0.48		
	Mar. 10, 1845	29.99	53.5	+ 3.0	+ 5.79	—2.79	—1.63	—1.1
66	Jan. 27, 1845	30.20	50.2	—15.5	—16.06	+0.56		
	Feb. 4, 1845	29.37	48.5	—24.6	—22.65	—1.95		
	Mar. 10, 1845	29.99	53.4	+ 5.2	+ 5.11	+0.09	—0.43	+0.0
67	Jan. 27, 1845	30.20	51.2	— 9.5	—10.47	+0.97		
	Mar. 10, 1845	29.99	53.3	+ 3.3	+ 4.42	—1.12	—0.07	+0.4
68	Jan. 27, 1845	30.20	50.9	—12.3	—12.26	—0.04		
	Mar. 10, 1845	29.99	53.4	+ 7.5	+ 5.11	+2.39	+1.17	+1.6
69	Jan. 29, 1845	30.12	52.4	— 2.3	— 2.89	+0.59		
	Mar. 10, 1845	29.99	53.3	+ 2.8	+ 4.42	—1.62	—0.51	—0.0
70	Feb. 8, 1845	30.24	49.0	—20.6	—21.06	+0.46		
	Mar. 10, 1845	29.99	53.3	+ 6.0	+ 4.42	+1.58	+1.02	+1.5
71	Jan. 31, 1845	30.04	52.0	— 6.2	— 5.65	—0.55		
	Mar. 10, 1845	29.99	53.2	+ 2.4	+ 3.75	—1.35	—0.95	—0.4
72	Jan. 30, 1845	30.20	51.2	—11.0	—10.47	—0.53		
	Feb. 4, 1845	29.37	48.3	—26.1	—23.21	—2.89		
	Mar. 10, 1845	29.99	53.2	+ 4.0	+ 3.75	+0.25	—1.06	—0.5
73	Jan. 31, 1845	30.06	51.6	— 7.3	— 8.15	+0.85		
	Mar. 11, 1845	29.83	51.3	—11.6	— 9.89	—1.71	—0.43	+0.0
74	Feb. 3, 1845	30.45	47.7	—25.1	—24.56	—0.54		
	Mar. 11, 1845	29.83	51.3	— 8.9	— 9.89	+0.99	+0.22	+0.7
75	Feb. 1, 1845	30.40	50.5	—13.8	—14.54	—0.74		
	Mar. 11, 1845	29.87	51.2	— 9.6	—10.47	+0.87	+0.06	+0.5
76	Jan. 30, 1845	30.23	50.3	—16.2	—15.58	—0.62		
	Mar. 11, 1845	29.91	51.1	—11.0	—11.06	+0.06	—0.28	+0.2
77	Feb. 6, 1845	29.79	50.3	—16.0	—15.58	—0.42		
	Mar. 11, 1845	29.91	51.0	—12.4	—11.66	—0.74	—0.58	—0.1
78	Feb. 4, 1845	29.44	47.6	—25.2	—24.82	—0.38		
	Mar. 11, 1845	29.96	51.1	—11.0	—11.06	+0.06	—0.16	+0.3
79	Feb. 11, 1845	29.75	48.4	—23.1	—22.93	—0.17		
	Mar. 12, 1845	30.35	50.7	—11.4	—13.41	+2.01		
	Jan. 5, 1846	30.22	50.2	—14.0	—16.06	+2.06	+1.30	+1.7
80	Feb. 4, 1845	29.44	47.4	—26.0	—25.32	—0.68		
	Mar. 12, 1845	30.35	51.3	—12.2	— 9.89	—2.31	—1.49	—1.0
81	Feb. 10, 1845	30.22	50.6	—14.4	—13.98	—0.42		
	Mar. 12, 1845	30.35	51.2	— 9.7	—10.47	+0.77	+0.17	+0.5
82	Feb. 7, 1845	30.20	50.4	—15.3	—15.10	—0.20		
	Mar. 12, 1845	30.35	51.0	—10.3	—11.66	+1.36	+0.58	+1.06

TABLE No. 3—Continued.

No. of standard.	Date.	Barometer.	Temperature of water.	Difference of weight from standard.	Correction for temperature.	Result. —Too large. +Too small.		
						Single.	Mean.	Corrected mean.
		Inches.	*Fahrenheit.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*
83	Feb. 8, 1845	30.30	49.0	—21.5	—21.06	—0.44		
	Mar. 12, 1845	30.35	50.8	— 9.8	—12.85	+3.05		
	Mar. 13, 1845	30.24	50.6	—13.4	—13.98	+0.58		
	Jan. 5, 1846	30.22	49.8	—20.4	—17.81	—2.59		
	Jan. 6, 1846	30.36	50.6	— 9.3	—13.98	+4.68	+1.06	+1.54
84	Feb. 13, 1845	30.28	52.8	— 0.4	+ 0.45	—0.85		
	Feb. 14, 1845	30.42	49.1	—21.1	—20.64	—0.46		
	Mar. 12, 1845	30.35	50.7	—12.2	—13.41	+1.21	—0.03	+0.45
85	Feb. 7, 1845	30.20	49.0	—20.2	—21.06	+0.86		
	Mar. 12, 1845	30.35	50.5	—14.1	—14.54	+0.44	+0.65	+1.13
86	Feb. 7, 1845	30.20	48.4	—22.3	—22.93	+0.63		
	Mar. 12, 1845	30.35	50.4	—14.8	—15.10	+0.30	+0.46	+0.94
87	Feb. 10, 1845	30.22	49.7	—18.8	—18.20	—0.60		
	Mar. 13, 1845	30.24	51.5	—10.1	— 8.73	—1.37	—0.98	—0.50
88	Feb. 12, 1845	29.60	50.2	—16.5	—16.06	—0.44		
	Mar. 13, 1845	30.24	51.5	— 8.9	— 8.73	—0.17	—0.30	+0.18
89	Feb. 14, 1845	30.42	48.6	—23.1	—22.37	—0.73		
	Mar. 13, 1845	30.24	51.3	— 9.9	— 9.89	—0.01	—0.37	+0.11
91	Feb. 14, 1845	30.42	48.4	—23.2	—22.93	—0.27		
	Mar. 13, 1845	30.24	51.1	—10.5	—11.06	+0.56	+0.14	+0.62
92	Feb. 13, 1845	30.35	52.1	— 4.5	— 4.99	+0.49		
	Feb. 14, 1845	30.42	48.9	—23.0	—21.38	—1.62		
	Mar. 13, 1845	30.24	51.0	— 9.7	—11.66	+1.96		
	Jan. 5, 1846	30.22	49.8	—16.0	—17.81	+1.81	+0.66	+1.14
93	Feb. 12, 1845	29.60	49.7	—18.1	—18.20	+0.10		
	Mar. 13, 1845	30.24	50.9	—12.8	—12.26	—0.54	—0.22	+0.26
94	Feb. 13, 1845	30.35	51.9	— 6.3	— 6.32	+0.02		
	Feb. 14, 1845	30.42	48.8	—22.5	—21.71	—0.79		
	Mar. 13, 1845	30.24	50.7	—12.8	—13.41	+0.61	—0.05	+0.43
95	Feb. 15, 1845	30.14	49.7	—18.5	—18.20	—0.30		
	Mar. 13, 1845	30.24	50.6	—15.0	—13.98	—1.02	—0.66	—0.18
96	Feb. 15, 1845	30.14	49.6	—18.8	—18.60	—0.20		
	Mar. 14, 1845	29.84	51.6	— 9.0	— 8.15	—0.85	—0.52	—0.04
97	Feb. 19, 1845	30.20	51.6	— 7.3	— 8.15	+0.85		
	Mar. 14, 1845	29.84	51.4	—10.3	— 9.31	—0.99	—0.07	+0.41
98	Feb. 25, 1845	30.00	53.5	+ 5.5	+ 5.79	—0.29		
	Mar. 14, 1845	29.84	51.3	— 8.5	— 9.89	+1.39	+0.55	+1.03
99	Feb. 25, 1845	30.00	53.6	+ 7.2	+ 6.47	+0.73		
	Mar. 14, 1845	29.84	51.1	—10.3	—11.06	+0.76	+0.74	+1.22
100	Feb. 26, 1845	29.82	53.8	+ 8.5	+ 8.26	+0.24		
	Mar. 14, 1845	29.70	51.0	— 8.7	—11.66	+2.96	+1.60	+2.08
101	Feb. 25, 1845	30.00	53.5	+ 6.0	+ 5.79	+0.21		
	Mar. 14, 1845	29.70	50.9	—11.1	—12.26	+1.16	+0.68	+1.16
102	Feb. 25, 1845	30.00	53.5	+ 6.5	+ 5.79	+0.71		
	Mar. 14, 1845	29.70	50.8	—10.5	—12.85	+2.35	+1.53	+2.01
103	Feb. 27, 1845	29.90	51.7	— 6.9	— 7.57	+0.67		
	Mar. 14, 1845	29.70	50.7	—13.5	—13.41	—0.09	+0.29	+0.77
105	Feb. 27, 1845	29.90	51.4	—10.0	— 9.31	—0.69		
	Mar. 15, 1845	29.94	51.0	—11.3	—11.66	+0.36	—0.16	+0.32
106	Feb. 28, 1845	29.99	50.6	—13.7	—13.98	+0.28		
	Mar. 15, 1845	29.94	50.9	—11.7	—12.26	+0.56	+0.42	+0.90
107	Mar. 1, 1845	29.90	50.1	—15.7	—16.54	+0.84		
	Mar. 15, 1845	29.94	50.8	—11.9	—12.85	+0.95	+0.89	+1.37
108	Feb. 27, 1845	29.90	51.3	— 9.2	— 9.89	+0.69		
	Mar. 15, 1845	29.94	50.7	—12.9	—13.41	+0.51	+0.60	+1.08
109	Mar. 1, 1845	29.90	49.9	—17.6	—17.42	—0.18		
	Mar. 15, 1845	29.94	50.5	—15.8	—14.54	—1.26	—0.72	—0.24

TABLE No. 3—Continued.

No. of standard.	Date.	Barometer.	Temperature of water.	Difference of weight from standard.	Correction for temperature.	Result. — Too large. + Too small.		
						Single.	Mean.	Corrected mean.
		Inches.	*Fahrenheit.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*
110	Feb. 28, 1845	29.99	50.4	—14.2	—15.10	+0.90		
	Mar. 15, 1845	29.94	50.4	—16.0	—15.10	—0.90	0.00	+0.4
112	Mar. 1, 1845	29.92	49.8	—18.0	—17.81	—0.19		
	Mar. 15, 1845	29.94	50.4	—13.0	—15.10	+2.10	+0.95	+1.4
113	Mar. 5, 1845	29.50	50.4	—14.2	—15.10	+0.90		
	Mar. 15, 1845	29.94	50.3	—13.8	—15.58	+1.78	+1.34	+1.8
114	Mar. 5, 1845	29.50	50.6	—13.6	—13.98	+0.38		
	Mar. 17, 1845	29.30	49.3	—16.6	—19.81	+3.21		
	Mar. 20, 1845	30.10	47.9	—23.4	—24.11	+0.71		
	Mar. 21, 1845	30.17	50.7	—13.6	—13.41	—0.19		
	Jan. 6, 1846	30.36	49.9	—13.8	—17.42	+3.62	+1.55	+2.0
115	Mar. 1, 1845	29.92	49.8	—18.0	—17.81	—0.19		
	Mar. 17, 1845	29.30	49.1	—19.4	—20.64	+1.24	+0.52	+1.0
116	Mar. 7, 1845	30.22	53.5	+ 5.9	+ 5.79	+0.11		
	Mar. 17, 1845	29.25	48.9	—20.8	—21.38	+0.58	+0.34	+0.8
117	Mar. 11, 1845	29.96	51.0	—10.9	—11.66	+0.76		
	Mar. 17, 1845	29.25	48.6	—23.1	—22.37	—0.73	+0.01	+0.4
118	Mar. 10, 1845	29.90	53.1	+ 3.9	+ 3.07	+0.83		
	Mar. 17, 1845	29.25	48.5	—22.0	—22.65	+0.65	+0.74	+1.2
119	Mar. 11, 1845	29.83	51.5	— 9.2	— 8.73	—0.47		
	Mar. 17, 1845	29.28	48.4	—23.0	—22.93	—0.07	—0.27	+0.2
120	Mar. 13, 1845	30.24	50.6	—14.6	—13.98	—0.62		
	Mar. 17, 1845	29.28	48.4	—24.2	—22.93	—1.27	—0.94	—0.4
121	Mar. 12, 1845	30.30	50.0	—17.4	—17.02	—0.38		
	Mar. 17, 1845	29.32	48.4	—24.0	—22.93	—1.07	—0.72	—0.3
122	Mar. 20, 1845	30.10	49.6	—18.8	—18.60	—0.20		
	Mar. 22, 1845	30.27	50.0	—16.6	—17.02	+0.42	+0.11	+0.5
124	Mar. 22, 1845	30.30	51.6	— 7.2	— 8.15	+0.95		
	Mar. 24, 1845	30.03	49.7	—17.9	—18.20	+0.30	+0.62	+1.1
125	Mar. 20, 1845	30.10	48.8	—20.9	—21.71	+0.81		
	Mar. 22, 1845	30.27	50.1	—16.7	—16.54	—0.16	+0.32	+0.8
126	Mar. 20, 1845	30.10	48.6	—21.7	—22.37	+0.67		
	Mar. 24, 1845	30.03	49.6	—16.7	—18.60	+1.90		
	Mar. 25, 1845	30.30	50.8	—13.3	—12.85	—0.45	+0.71	+1.1
127	Mar. 19, 1845	29.94	49.9	—17.1	—17.42	+0.32		
	Mar. 25, 1845	30.30	50.7	—12.1	—13.41	+1.31	+0.81	+1.3
128	Mar. 20, 1845	30.10	48.4	—22.4	—22.93	+0.53		
	Mar. 25, 1845	30.30	50.9	—11.7	—12.26	+0.56	+0.54	+1.0
129	Mar. 18, 1845	29.64	50.2	—16.0	—16.06	+0.06		
	Mar. 25, 1845	30.30	51.0	—10.9	—11.66	+0.76	+0.41	+0.8
130	Mar. 19, 1845	29.94	49.5	—18.2	—18.99	+0.79		
	Mar. 26, 1845	30.50	51.3	—11.0	— 9.89	—1.11		
	Jan. 5, 1846	30.23	49.4	—21.5	—19.38	—2.12	—0.81	—0.3
131	Jan. 7, 1846	29.75	50.0	—16.2	—17.02	+0.82		
	Jan. 22, 1846	30.20	50.2	—13.7	—16.06	+2.36		
	Mar. 28, 1846	29.90	52.50	+ 2.2	— 2.18	+4.38		
	Mar. 30, 1846	30.25	51.25	— 7.3	—10.18	+2.88	+2.61	+3.1
132	Mar. 22, 1845	30.30	50.7	—13.6	—13.41	+0.19		
	Mar. 26, 1845	30.50	51.3	— 8.6	— 9.89	+1.29	+0.74	+1.3
133	Mar 21, 1845	30.17	50.0	—16.2	—17.02	+0.82		
	Mar. 26, 1845	30.50	51.2	— 9.9	—10.47	+0.57	+0.69	+1.1
134	Mar. 25, 1845	30.28	51.3	—10.5	— 9.89	—0.61		
	Mar. 26, 1845	30.50	51.1	—13.7	—11.06	—2.64		
	Jan. 8, 1846	30.00	50.3	—14.4	—15.58	+1.18		
	Jan. 22, 1846	30.20	49.9	—18.0	—17.42	—0.58	—0.66	—0.1
136	Mar. 24, 1845	30.03	49.9	—18.1	—17.42	—0.68		
	Mar. 26, 1845	30.50	50.9	—12.7	—12.26	—0.44	—0.56	—0.0

TABLE No. 3—Continued.

No. of standard.	Date.	Barometer.	Temperature of water.	Difference of weight from standard.	Correction for temperature.	Result. — Too large. + Too small.		
						Single.	Mean.	Corrected mean.
		Inches.	*Fahrenheit.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*
137	Jan. 9, 1846	29.98	50.9	—11.3	—12.26	+0.96		
	Jan. 22, 1846	30.20	49.6	—21.1	—18.60	—2.50	—0.77	—0.29
138	Jan. 8, 1846	30.00	49.8	—18.0	—17.81	—0.19		
	Jan. 22, 1846	30.20	49.5	—20.0	—18.99	—1.01	—0.60	—0.12
139	Jan. 9, 1846	29.98	50.6	—13.0	—13.98	+0.98		
	Jan. 23, 1846	30.55	51.6	— 9.8	— 8.15	—1.65	—0.33	+0.15
140	Jan. 10, 1846	30.00	49.1	—20.4	—20.64	+0.24		
	Jan. 23, 1846	30.55	51.5	— 5.2	— 8.73	+3.53		
	Mar. 28, 1846	29.90	52.2	— 3.6	— 4.32	+0.76		
	Mar. 30, 1846	30.25	51.1	—10.1	—11.06	+0.96	+1.37	+1.85
141	Jan. 10, 1846	30.00	49.0	—21.0	—21.06	+0.06		
	Jan. 23, 1846	30.55	51.1	—11.0	—11.06	+0.06	+0.06	+0.54
143	Jan. 10, 1846	30.00	48.9	—20.7	—21.38	+0.68		
	Jan. 23, 1846	30.55	50.7	—18.2	—13.41	—4.79		
	Jan. 24, 1846	30.40	51.1	—10.4	—11.06	+0.66	—1.15	—0.67
144	Jan. 14, 1846	30.20	48.5	—23.1	—22.65	—0.45		
	Jan. 23, 1846	30.55	50.4	—16.0	—15.10	—0.90	—0.67	—0.19
145	Jan. 20, 1846	30.50	49.8	—19.3	—17.81	—1.49		
	Jan. 23, 1846	30.55	50.0	—18.9	—17.02	—1.88	—1.68	—1.20
146	Jan. 13, 1846	30.23	49.6	—19.3	—18.60	—0.70		
	Jan. 24, 1846	30.40	50.5	—16.0	—14.54	—1.46	—1.08	—0.60
147	Jan. 14, 1846	30.20	47.8	—25.2	—24.31	—0.89		
	Jan. 24, 1846	30.40	50.0	—18.3	—17.02	—1.28		
	Mar. 28, 1846	29.90	51.95	— 6.2	— 5.98	—0.22		
	Mar. 30, 1846	30.25	50.95	—11.3	—11.96	+0.66	—0.43	+0.05
148	Jan. 13, 1846	30.23	48.9	—21.7	—21.38	—0.32		
	Jan. 24, 1846	30.40	49.8	—19.0	—17.81	—1.19		
	Jan. 26, 1846	29.92	50.7	—13.2	—13.41	+0.21	—0.43	+0.05
149	Jan. 14, 1846	30.20	47.5	—25.8	—25.07	—0.73		
	Jan. 24, 1846	30.40	49.4	—20.7	—19.38	—1.32	—1.02	—0.54
150	Jan. 17, 1846	29.70	50.7	—14.3	—13.41	—0.89		
	Jan. 24, 1846	30.40	49.1	—22.3	—20.64	—1.66	—1.27	—0.79
151	Jan. 21, 1846	29.78	51.5	— 9.5	— 8.73	—0.77		
	Jan. 24, 1846	30.40	48.8	—22.0	—21.71	—0.29	—0.53	—0.05
152	Jan. 20, 1846	30.50	50.4	—13.4	—15.10	+1.70		
	Jan. 26, 1846	29.92	50.4	—17.0	—15.10	—1.90	—0.10	+0.38
154	Jan. 19, 1846	30.49	48.0	—23.0	—23.90	+0.90		
	Jan. 26, 1846	29.92	50.3	—18.0	—15.58	—2.42	—0.76	—0.28
155	Jan. 20, 1846	30.50	49.5	—19.7	—18.99	—0.71		
	Jan. 26, 1846	29.87	50.2	—19.2	—16.06	—3.14		
	Jan. 27, 1846	29.75	51.3	—10.4	— 9.89	—0.51	—1.45	—0.97
156	Jan. 21, 1846	29.78	50.6	—15.0	—13.98	—1.02		
	Jan. 26, 1846	29.87	51.8	— 8.0	— 6.99	—1.01	—1.01	—0.53
157	Jan. 22, 1846	30.20	51.6	— 7.7	— 8.15	+0.45		
	Jan. 26, 1846	29.80	51.5	— 8.6	— 8.73	+0.13		
	Jan. 27, 1846	29.75	51.1	—12.2	—11.06	—1.14	—0.19	+0.29
159	Jan. 21, 1846	29.72	52.0	— 4.7	— 5.65	+0.95		
	Jan. 27, 1846	29.75	51.0	—13.2	—11.66	—1.54		
	Jan. 28, 1846	30.03	52.5	— 0.7	— 2.18	+1.48		
	Jan. 28, 1846	30.03	51.9	— 6.0	— 6.32	+0.32		
	Jan. 28, 1846	30.03	51.4	—10.3	— 9.31	—0.99		
	Jan. 28, 1846	30.03	51.2	— 9.1	—10.47	+1.37		
	Jan. 28, 1846	30.03	51.0	—12.6	—11.66	—0.94	+0.09	+0.57
160	Jan. 23, 1846	30.55	48.1	—24.1	—23.70	—0.40		
	Jan. 27, 1846	29.75	50.9	—10.7	—12.26	+1.56		
	Jan. 28, 1846	30.03	52.0	— 5.3	— 5.65	+0.35		
	Jan. 28, 1846	30.03	51.7	— 5.6	— 7.57	+1.97		

TABLE No. 3—Continued.

No. of standard.	Date.	Barometer.	Temperature of water.	Difference of weight from standard.	Correction for temperature.	Result. — Too large. + Too small.		
						Single.	Mean.	Corrected mean.
		Inches.	*Fahrenheit.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*
160	Jan. 28, 1846	30.03	51.3	— 8.3	— 9.89	+1.59		
	Jan. 28, 1846	30.03	51.0	—12.0	—11.66	—0.34		
	Jan. 28, 1846	30.03	50.9	—13.5	—12.26	—1.24	+0.50	+0.98
161	Jan. 22, 1846	30.20	50.6	—15.0	—13.98	—1.02		
	Jan. 27, 1846	29.75	50.7	—15.2	—13.41	—1.79	—1.40	—0.92
162	Jan. 27, 1846	29.75	51.3	—10.6	— 9.89	—0.71		
	Jan. 27, 1846	29.75	50.6	—14.4	—13.98	—0.42		
	Mar. 28, 1846	29.90	51.8	— 8.1	— 6.99	—1.11		
	Mar. 30, 1846	30.25	51.0	— 9.6	—11.66	+2.06	—0.04	+0.44

The weights actually used in adjusting these measures have been compared with the standard Troy pound of the establishment, and the result is applied as a correction to the eighth column of the foregoing table, giving the final result, uncorrected only for any difference which may exist between this pound and the legal standard Troy pound deposited at the United States mint.

The average difference in consecutive weighings of the different measures is shown in the following table, in which the number of each measure is stated, and the difference between the first and second weighings in the final comparison.

TABLE No. 4.

Showing the difference between the first and second weighings of the same measure.

No. of measure.	Difference of first and second weighings.	No. of measure.	Difference of first and second weighings.	No. of measure.	Difference of first and second weighings.	No. of measure.	Difference of first and second weighings.	No. of measure.	Difference of first and second weighings.	No. of measure.	Difference of first and second weighings.
	Grains.		*Grains.*		*Grains.*		*Grains.*		*Grains.*		*Grains.*
31	+1.04	54	+2.06	75	+1.61	96	−0.65	118	−0.18	140	−3.29
32	−0.46	55	+0.27	76	+0.68	97	−1.84	119	+0.40	141	0.00
33	+2.26	56	+0.52	77	−0.32	98	+1.68	120	−0.65	143	−5.47
34	−2.32	57	−0.95	78	+0.44	99	+0.03	121	−0.69	144	−0.45
36	−0.90	58	−1.77	79	+2.18	100	+2.72	122	+0.62	145	−0.39
37	+1.50	59	+0.42	80	−1.63	101	+0.95	124	−0.65	146	−0.76
38	−1.64	60	−2.34	81	+1.19	102	+1.64	125	−0.97	147	−0.39
39	−0.62	61	+1.27	82	+1.56	103	−0.76	126	+1.23	148	−0.87
40	−0.62	62	+1.21	83	+3.49	105	+1.05	127	+0.99	149	−0.59
41	+0.02	63	−0.53	84	+0.39	106	+0.28	128	+0.03	150	−0.77
43	−0.43	64	−2.31	85	−0.42	107	+0.11	129	+0.70	151	+0.48
45	+2.97	66	−2.51	86	−0.33	108	−0.18	130	−1.90	152	−3.60
46	−2.52	67	−2.09	87	−0.77	109	−1.08	131	+1.54	154	−3.32
47	−1.46	68	+2.43	88	+0.27	110	−1.80	132	+1.10	155	−2.43
48	−1.43	69	−2.21	89	+0.72	112	+2.29	133	−0.25	156	+0.01
49	+0.91	70	+1.12	91	+0.83	113	−0.88	134	−2.03	157	−0.32
50	−1.99	71	−0.80	92	−2.11	114	+2.83	136	−0.24	159	−2.49
51	+2.67	72	−2.36	93	−0.64	115	+1.43	137	−3.46	160	+1.96
52	−1.94	73	−2.56	94	−0.81	116	+0.69	138	−0.82	161	−2.81
53	−2.94	74	+1.53	95	−0.72	117	−1.49	139	−2.63	162	+0.29

Mean, without regard to signs, 1.32 grains.

The average of these differences, without regard to signs, is one grain and thirty-two hundredths in 38.8137 pounds avoirdupois, or $\frac{1}{2\,0\,5\,\frac{1}{8}\,3\,0}$ths of the whole weight; the greatest difference is five grains and forty-seven hundredths, or $\frac{1}{4\,9\,6\,\frac{1}{7}\,0}$ths of the whole weight of water in the measure. The proportionate number for the mean is a little less than that obtained for the gallon, which was $\frac{1}{2\,0\,1\,2\,8\,6}$. The same proportionate accuracy, then, is attainable in these large weights, amounting in this case of the half-bushel measures to about one hundred pounds in each scale, as in the less weight of the gallons, amounting to about $31\frac{1}{4}$ lbs. The probable error or uncertainty in one comparison or weighing is shown in the following table:

TABLE No. 5.

Showing the probable error of a single weighing, and of the mean of several weighings.

No. of standard.	No. of weighings.	Probable error of one weighing.	Probable error of the mean.
		Grains.	*Grains.*
45	5	1.20	0.53
83	5	1.93	0.86
92	4	1.18	0.59
114	5	1.17	0.52
131	4	0.99	0.50
134	4	1.05	0.53
140	4	0.98	0.49
147	4	0.57	0.29
159	7	0.84	0.32
160	7	0.79	0.30
162	4	0.97	0.48
Mean - -	- -	1.06	0.49

The most probable error of one comparison is about one grain, and of the mean of from four to seven comparisons about half a grain; a degree of uniformity only to be reached by practice in the manipulations.

After these operations the polish of the exterior of the measures was in a considerable degree impaired; this was renewed, and the first comparisons of verification were made by Mr. Saxton.

The results are shown in the following table:

TABLE No. 6.

Showing the first verification of the half-bushel measure.

No. of standard.	Date.	Barometer.	Temperature of water.	Difference of weight from standard.	Correction for temperature.	Result. (+Too small. −Too large.)	Corrected mean.*	Results previously obtained. Greatest.	Results previously obtained. Least.
	1846.	*Inches.*	*Fahrenheit.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*
45	Jan. 5	30.23	49.3	—17.2	—19.81	+2.61	+3.09	—0.81	+3.49
79	5	30.22	50.2	—14.0	—16.06	+2.06	+2.54	+0.31	+2.49
83	5	30.22	49.8	—20.4	—17.81	—2.59			
	6	30.36	50.6	— 9.3	—13.98	+4.68	+1.52	+0.04	+3.55
92	5	30.22	49.8	—16.0	—17.81	+1.81	—2.29	—1.24	+2.44
114	6	30.36	49.9	—13.8	—17.42	+3.62	+8.13	+0.29	+3.69
130	5	30.23	49.4	—21.5	—19.38	—2.12	—1.64	—0.63	+1.27

* Corrected for difference of weights from standard in office.

The measures were then polished, and, four having been selected for the purpose, two trials were made on different days, under my immediate inspection. It is needless, almost, to observe that no memorandum was referred to until after these trials were made. They were thus at once tests of the accuracy of the previous comparisons, and of the care taken, in polishing the exterior, to do no harm. Had these trials shown any necessity for further verification, the present one including ten measures out of one hundred and twenty-one, other comparisons would of course have been made.

TABLE No. 7.

Showing the second verification of the half-bushel measures.

No. of standard.	Date.	Barometer.	Temperature of water.	Difference of weight from standard.	Correction for temperature.	Result. — Too large. + Too small.		Results previously obtained.	
						Single.	Corrected mean.	Greatest.	Least.
	1846.	*Inches.*	*Fahr.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*
131	Mar. 28	29.90	52.50	+ 2.2	— 2.18	+4.38			
	Mar. 30	30.25	51.25	— 7.3	—10.18	+2.88	+4.51	+1.30	+2.84
140	Mar. 28	29.90	52.20	— 3.6	— 4.32	+0.76			
	Mar. 30	30.25	51.10	—10.1	—11.06	+0.96	+1.32	+0.72	+4.01
147	Mar. 28	29.90	51.95	— 6.2	— 5.98	—0.22			
	Mar. 30	30.25	50.95	—11.3	—11.96	+0.66	+0.70	—0.80	—0.41
162	Mar. 28	29.90	51.80	— 8.1	— 6.99	—1.11			
	Mar. 30	30.25	51.00	— 9.6	—11.66	+2.06	+0.95	—0.23	+0.06

The following table contains, in the second column, the corrected means of the several weighings of comparisons; in the third, the corrected means of the weighings of verification; and in the fourth and fifth, the differences of the two sets of means.

TABLE 8.

Containing the mean results of weighings of comparison and of verification, and their differences.

No.	Corrected means.	Corrected means of weighings of verification.	Difference.	
	Grains.	*Grains.*	*Grains.*	*Grains.*
45	+1.09	+3.09	- -	—2.00
79	+1.40	+2.54	- -	—1.14
83	+2.07	+0.04	+2.03	
92	+0.89	—1.24	+2.13	
114	+1.51	+4.10	- -	—2.59
130	+0.32	—1.64	+1.96	
131	+2.07	+1.30	+0.77	
140	+2.36	+0.72	+1.64	
147	—0.60	+0.70	+0.10	
162	—0.08	+0.47	+0.39	
			8.92	—5.73
		Mean difference	0.22	

The new weighings do not generally differ from the old more than the latter do among themselves. The average of the differences, without regard to signs, is 1.46 grains, and, with regard to signs, 0.22 grains. The greatest difference is but 2.6 grains in the weight of the half-bushel, or $\frac{1}{20583}$ of the whole weight.

It was desirable, in order to preserve the exterior polish of the measures, to lacquer them; and trials were made of the effect of the temperature required to produce proper adherence of the varnish. The results in two cases where the experiments were elaborate are given in the annexed table. The half-bushel No. 159 was heated merely to the requisite degree, and No. 160 was overheated.

TABLE No. 9.

Showing the effect of heating the half-bushel measures.

No. of standard.	Date.	Barometer.	Temperature of water.	Difference of weight from standard.	Correction for temperature.	Result. — Too large. + Too small.		Remarks.
						Single.	Corrected mean.	
	1846.	*Inches.*	*Fahr.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	
159	Jan. 28	30.03	52.5	— 0.7	— 2.18	+1.48	-	Weighed with distilled water, as usual.
	Jan. 28	30.03	51.9	— 6.0	— 6.32	+0.32		
	Jan. 28	30.03	51.4	—10.3	— 9.31	+0.99		
	Jan. 28	30.03	51.2	— 9.1	—10.47	+1.37		
	Jan. 28	30.03	51.0	—12.6	—11.66	—0.94	+1.12	
160	Jan. 28	30.03	52.0	— 5.3	— 5.65	+0.35		
	Jan. 28	30.03	51.7	— 5.6	— 7.57	+1.97		
	Jan. 28	30.03	51.3	— 8.3	— 9.89	+1.59		
	Jan. 28	30.03	51.0	—12.0	—11.66	—0.34		
	Jan. 28	30.03	50.9	—13.5	—12.26	—1.24	+0.95	
159	Jan. 31	29.76	54.6	+17.4	—15.91	+1.49	-	Weighed with distilled water, after having been lacquered.
	Jan. 31	29.76	54.6	+14.7	—15.91	—1.21		
	Jan. 31	29.76	54.6	+13.8	—15.91	—2.11		
	Jan. 31	29.76	54.6	+14.6	—15.91	—1.31	—0.30	
160	Jan. 31	29.76	54.6	+12.1	—15.91	—3.81	-	No. 160 was overheated.
	Jan. 31	29.76	54.6	+11.7	—15.91	—4.21		
	Jan. 31	29.76	54.6	+12.3	—15.91	—3.61		
	Jan. 31	29.76	54.6	+11.3	—15.91	—4.61	—3.58	

The probable error of the mean of the seven determinations of No. 159, before heating, is less than four-tenths of a grain, and of the four determinations after heating, less than six-tenths; while the apparent permanent enlargement by heating is one grain and forty-two hundredths. So of No. 160, the probable error of the mean of the five weighings before heating, and of the four after heating, is about five-tenths of a grain; while the apparent permanent enlargement is four grains and fifty-three hundredths.

It was determined, therefore, not to heat the measure for the purpose of lacquering. They were simply polished on their exterior before packing in their boxes. A stamp, with the number of the measure, was impressed upon the upper exterior rim, above the inscription "United States standard

half-bushel, 1842," and in the lower rim an eagle, the letter B, and the figures 1846.

These measures are now ready for distribution, under the direction of the Treasury Department. Their completion finishes this part of the work, except the supply which may be required for the new States.

OF THE WORK UPON THE BALANCES, AND THEIR DISTRIBUTION.

The delivery of the first set of balances showed that, besides the precaution of sending a competent person to set the instruments up and explain their use in the adjustment of standards, it was necessary to take a preliminary one in reference to their safe-keeping, by the provision of a suitable place by the State receiving them. I accordingly addressed a circular letter to the executive of the several States, to which, by direction of the Treasury Department, the balances first made were to be delivered, stating that the instruments were ready for delivery; that it was desirable, for their preservation, that they should be placed in a fire-proof room or building; and giving a plan, with the dimensions of a room or building suitable for containing the balances and the standards of weights and measures. The balances now prepared will be sent to their destination as soon as called for, the arrangement thus contemplated being recommended, however, as a preliminary in every case. In the new state-house of the Commonwealth of New Jersey a room has been prepared especially for this purpose; and a very suitable place has been furnished in the state-house at Albany, New York. Locks have been put upon the cases of the instruments, the keys of which are deposited with the State superintendent of weights and measures, and descriptive labels have been placed conspicuously upon the instruments to secure their use for the purpose of adjusting standards only.

Advantage has been taken of the delivery of the balances to ascertain the condition of standards heretofore delivered to custom-houses and States, near the route necessarily travelled. From this I expect much benefit in securing the proper use and care of the standards of weights and measures.

The usual steps in the making of the balances, which apply to nearly all the pieces composing them, are casting, rough-filing, smooth-filing, or turning and finishing. When all the pieces are finished, the balance is put together upon its table and adjusted; the case of the balance and cover of the table are arranged; the instrument is then taken to pieces as far as is necessary for packing, and is packed ready for delivery.

The following table shows the number of pieces which have been cast, and those which have gone through the different stages of progress mentioned above, in the year between the first of January, 1845, and the first of January, 1846. The per centage of the whole number of pieces is given—a careful comparison of the number of pieces according to the new construction having been made. The pieces are classified approximately, according to their relative difficulty of execution, into three classes—the first including the larger or more difficult pieces. In this latter respect, the form adopted in my report of last year is followed; but the arrangement into the different steps of the progress is more perspicuous than the former one.

TABLE No. 10.

Showing the progress of the balances from January, 1845, to January, 1846.

Classification of pieces.	Cast.	Cast to rough filed.	Rough filed to smooth filed or turned.	Smooth filed or turned to finished.	Per cent. of the whole number of pieces.				Per ct. of the whole number of balances set up, adjusted, &c.
					Cast.	Cast to rough filed.	Rough filed to smooth filed.	Smooth filed to finished.	
First class -	186	246	93	205	11	14	5	12	17
Second class -	1090	926	357	830	17	15	6	13	17
Third class -	796	757	548	1443	6	6	4	11	0

In addition to this work, five balances have been altered to the new pattern. The amount of work of alteration is thus to be added to that shown in the table, to give the amount for the year. In the alterations 612 pieces were replaced by 264, which proves that Mr. Saxton's changes have simplified the construction. Drawings and descriptions of the parts thus altered will be given in my next report.

By attaching relative weights to the different stages of progress of the pieces, and to the labor of setting up and adjusting, the progress of the whole work is obtained numerically. An average taken in this way of the per centage given in the table, gives about one-seventh of the whole work for the progress of the year. This is in addition to the work upon the weights and measures.

Very respectfully submitted by

A. D. BACHE,
Superintendent of Weights and Measures.

Hon. R. J. WALKER,
Secretary of the Treasury.